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Abstract

This paper describes the design of groupware for virtual organizations that share certain characteristics. First the concept of virtual organizations is introduced. Then our application partner, the "virtual" service company Sigma, and our empirical work at Sigma are described. The identified problems are categorized and discussed. Finally, we present the derived aspects for the design of groupware in the context of virtual organizations.

Keywords: Virtual organizations, groupware, IS design.

1. INTRODUCTION

Due to the globalization of markets and the growing need to react to the increased speed, a growing number of organizations have been established or modified in the past few years that no longer consider Weber's model of bureaucracy or Taylor's scientific management to be adequate for modern business. Among the most commonly used terms found for these developing organization forms is "virtual organization" (VO).

The emergence of such non-classical organization forms presents a challenge to IS research. Particularly for work in the field of computer supported cooperative work (CSCW), which is concerned with the design, introduction, and use of groupware systems, the dynamics and diversity of different organizations and groups require a broad methodological repertoire and a deep understanding of the work context in a concrete organization. These aspects are even more important in virtual organizations, which are less rigidly structured and much more flexible than classical organizations. We are aware that all of the problems described below are not problems pertaining only to a VO. Actually, most of the problems appear in classical organizations, too. However, we argue that the appearance of these problems is much more intense and frequent in VOs and that the problems are not accidental but rather due to inherent organizational features of Vos.

2. VIRTUAL ORGANIZATIONS

In the literature, there is some disagreement about what exactly a VO is and what characteristics constitute it. In the discussion about VOs, different authors mention a whole bundle of different features which are supposed to be more or less characteristic for a VO. Among those are the idea that a VO is a form of cooperation of legally independent companies or people contributing their core competencies to a vertical or horizontal integration and appearing as one organization to the customer. The literature also stresses the importance of information and communication systems and the fact that hierarchies in VOs are flat and central control functions are not established. Most authors state that the VO is established for a limited time only and that the participants of a VO are usually geographically distributed. However, there is no general agreement as to how important these features are

and which other features may add to the VO. A good overview of the different definitions and how VOs relate to networks, joint ventures, strategic alliances, agile enterprises, value-adding partnerships, or clan organizations is provided by Arnold and Härtling (1995) and Strausak (1998). An approach to VOs rooted in classical organization theory rather than in business administration or information systems theory contrasts an ideal type of the VO with Weber's ideal type of a bureaucratic organization while emphasizing information and communication technology. In this ideal VO, files are kept electronically, communication takes place by computer-mediation, and clear external boundaries of the organization are difficult to establish (Nohria and Berkley 1994). While there are some prominent examples of VOs, such as Rosenbluth International Alliance (cf. Miller, Clemons, and Row [1993] for a comprehensive account of this VO, a global cooperative alliance of independent travel agencies), other companies described as VOs show a considerably different structure or work practice. Some authors provide as examples of VOs companies that team up networked freelancers for a project, are small enterprises organizing the work along the whole value chain, are cooperative networks of more than a dozen organizations for the development and marketing of a high-tech product, concentrate on core competencies by outsourcing, or, quite contrarily, integrating middlemen and retailers in logistics (e.g. Arnold et al. 1995), to mention only a few.

What is common to the definitions and examples is that they hint at some enabling factors for those VOs having a structure determined by project teams:

- *Trust* among the partners of a VO is considered to be vital since there are not the same kinds of rigid formal obligations as in classical hierarchical organizations.
- The ability to build *flexible teams* is highly important to secure the VO's flexibility to react to market demands.
- *Communication, cooperation,* and *coordination* require particular attention because a VO needs more of all three and is less structured than other organizations.

3. SIGMA: AN EXAMPLE OF A VO

3.1 Organization

The field of our empirical work is a training and consulting company that shall be called Sigma and that labels itself as a virtual organization, where the "virtuality" consists of the fact that Sigma is a network of about 200 mainly freelancing consultants and trainers who build small or large teams to work on projects. Thus, Sigma is a team-oriented VO as described in Picot, Reichwald, and Wigand p. 394). Some of the consultants and trainers receive payments on a regular basis for which they have to provide the respective turnover at the end of the year and work for Sigma full-time or nearly full-time. Others only work for Sigma temporarily when there is need for their skills in a project. Sigma operates nationwide in Germany, with the organization members usually working in their "home offices". The recent establishment of eight regional branches reflects the importance of personal relationships for the organization. Staff for a new project is recruited from Sigma members via acquaintance or recommendation. Sigma is, in fact, a VO not only by self-definition but also given its organizational characteristics: projects are carried out by legally independent freelancers who combine their core competencies for a temporary project and sell the end-product to a customer under the common label of Sigma. There is a flat hierarchy, and communication and cooperation is based on information and communication technology (see below). The relationship between (most of the) people working for Sigma is best characterized by what Powell (1990) attributes to a network as opposed to both market and hierarchy: The common notion of complementary strengths of individuals who cooperate hoping for mutual benefits and knowing about their interdependence creates a notion of reciprocity that outweighs the egoism of pure market behavior and is not bound by hierarchical limitations. It remains, however, unclear how this fragile form of network organization can be maintained.

3.2 Technology

About two years ago, Sigma started using the mailbox system SigSys, which can be accessed by any project member that is granted permission by the Sigma management. While SigSys is not a groupware in the strictest sense, it still contains features that are vital for Sigma's internal communication and cooperation. Currently, about 150 individuals have access to the system. SigSys can be operated via modem or ISDN. With SigSys, people can exchange mail within Sigma or to and from the Internet

and access Sigma-internal mailing lists, which deal with issues pertaining to certain projects or regional groups. Moreover, SigSys permits the sending and receiving of binary data like text documents or overhead presentations that are often exchanged between members of a project team. SigSys has a comparatively simple functionality but has some advantages compared to an ordinary Internet access via a provider, particularly being a medium for the internal usage within Sigma with the respective access restrictions and possibilities for regulation and being easier to install and at a lower cost.

4. EMPIRICAL WORK

To provide Sigma with adequate suggestions for the design of technology for their internal communication and cooperation, we applied different empirical methods in order to understand the organization and the work of selected members.

4.1 Procedure of Empirical Work

In October and November 1997, we conducted 16 interviews with Sigma members. The interviews lasted from 45 to 90 minutes. The individuals interviewed represented a cross-section of the staff working with Sigma and included members of the management and people working full-time for Sigma, as well as freelancers working part time. These interviews reflected the enormous heterogeneity of perspectives of different individuals in Sigma. Moreover, we took part in a working group about Sigma's information and knowledge management and acted as participating observers in SigSys, following discussion threads about project and organizational contents and about the usability of SigSys itself.

4.2 Results of the Empirical Investigation

The target of our investigation was to identify organizational problems within Sigma, problems in the application of SigSys, as well as usability problems of SigSys. While one could argue that SigSys is not representative of software used for internal communication and cooperation, we still believe that the usage of SigSys and its analysis are crucial to an understanding of the problems that Sigma faces in the large area where organization and technology meet. First, SigSys was chosen as a software that does not make heavy demands on people's hardware or software nor on their abilities to handle their computers and because it is a closed system bypassing Internet security problems. Thus, SigSys represents a whole range of lightweight systems adequate for VOs in the mentioned aspects. Second, many of the problems involved in the use of SigSys are actually independent of the user interface or functionality. For some of those, SigSys is a focal point by the usage of which some hidden peculiarities suddenly become obvious. Third, while many of SigSys's features may be proprietary, they still hint at technological problems independent of a particular system such as questions of access, the structuring of information or decentralized installation and support of a software product.

The relationship between organizational problems and the problems regarding the use of SigSys will be shown from two different angles. The first aspect is illustrated in Figure 1 and discusses organizational problems or requirements we came across in our exploration. Each problem category listed in the box on the right of the diagram relates to a particular task that the organization as a whole has to perform. The execution of this task is hindered by the problems described in detail in the following section. All of these problems reflect the need for support through information technology, in particular groupware. We will consider how far SigSys meets these requirements. The second aspect is illustrated in Figure 2. The discussion of this aspect deals more with problems that appeared in the use of SigSys. While SigSys should facilitate the execution of various tasks/ activities, several problems occurred. The problems explored here are localized at the border between the organization and its individuals on the one hand and SigSys and its application on the other.

The following discussion presents only an outline of the problems that we identified in our investigations in Sigma. We are aware of the fact that only a selection of possible problems that can occur within VOs are represented. Furthermore, the problems may be in part peculiar to the VO Sigma and therefore not be significant in general. However, we think that the problems we have identified can serve as a sound basis for further exploration of the subject of supporting VOs through groupware.

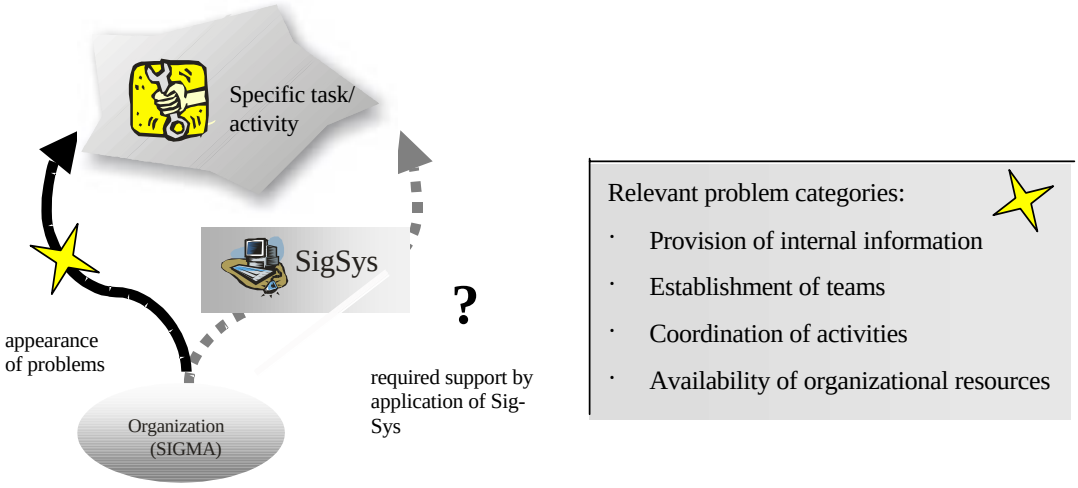

Figure 1. Lack of Support with Regard to Organizational Requirements

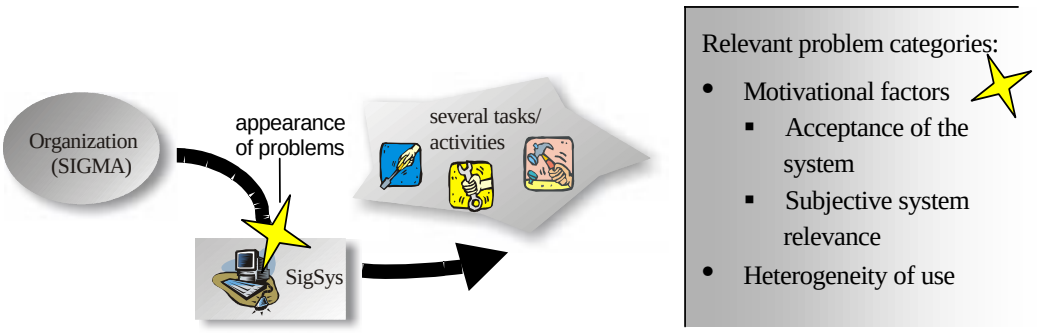

Figure 2. General Problems Regarding the Use of SigSys

4.3 Problem Category 1: Lack of Support with Regard to Organizational Requirements

In this section, we will describe the problems we have identified in four clusters. At the end of each cluster we will discuss how far the application of SigSys supports the solution of the problems.

4.3.1 Providing Internal Information

The following problems mainly relate to the activity of providing different kinds of information within the organization.

- *Visibility of activities and decisions*. Many members of Sigma complained about the lack of visibility of work processes and decisions within Sigma. Decisions made by the board of directors or the management of the regional branches are often not communicated well. Several people complained about a lack of involvement in the discussion of decisions. Regarding activities, many members wished to know more about what is going on within Sigma. The factors responsible for the problems regarding processes of decision-making seem to be multidimensional. On the one hand, the questions about whether decisions are communicated broadly and how far members of the organization can participate in decisions relate to different notions of "management culture," in particular the interest of the management to involve members in decision-

making processes. This part of the problem is, therefore, purely due to organizational issues. On the other hand, the communication of decisions and discussion processes over decisions is limited by the use of an adequate IT.

- *Visibility of organization structure*. As Sigma is a complex and geographically distributed network, its structure is not easy to comprehend. Questions about responsibilities, organizational arrangements, contact persons, etc., have to be answered. In our investigation, many people were unsure about whom to contact for several affairs. The situation is aggravated by the fact that Sigma lacks binding arrangements in some areas and shows variable interpretations of arrangements in others.

There are problems providing internal information regarding the use of SigSys. *Access rights*: As some decisions are not to be discussed organization-wide but only by a selected group of organization members, a dedicated access policy on system resources is essential. Currently, SigSys provides only few tools to manage access rights. These refer solely to discussion groups but not to documents or artifacts. *Structured information*: Information in SigSys is structured in several discussion groups. The information within the discussion groups remains unstructured. This is a problem for both gaining an overview of activities within Sigma and an appropriate representation of organization structure.

4.3.2 Establishment of Teams

- *Availability of skill information*. Support for the establishment of teams is a vital prerequisite for virtual organizations. As a result of Sigma's geographical distribution, personal acquaintance is rather limited in general. Members of Sigma often find it difficult to find the right personnel when establishing a team. Currently, the mechanism of finding personnel within Sigma consists of three levels. In a first step, the person seeking to establish a team looks for people he knows. If this fails, he will ask other members of the organization whether they can recommend someone. In the event that he still has not been able to locate new staff, the inquiry is posted in SigSys.

Within SigSys there is no particular support for the provision of skill information.

4.3.3 *Coordination of Activities*

The need regarding coordination differs depending on whether it relates to a team or to the organization as a whole. Regarding the coordination within teams, members of Sigma mentioned the need for standard coordination tools. These should include features like project management and the planning of team schedules. Regarding the organization as a whole, there is a high demand for coordinating several activities within the organization. Points mentioned were coordination of contacts with the customer, coordination of training activities, and time schedule coordination.

All coordination activities in SigSys are handled via e-mail and discussion groups. Currently there is no direct support for coordination.

4.3.4 *Availability of Organizational Resources*

As Sigma consists mainly of freelancers, there is a problem in providing general services for the whole organization. Since most of the members of the organization are responsible for their income and regard themselves as independent contractors, they cannot be obliged to provide general services to the organization. The organization itself cannot provide all the needed services either because it depends on the work that is done by its members. However, the availability of money that the organization can spend for general services is limited. In the context of our investigation, many Sigma members complained about the lack of support in areas such as the provision of information, the availability of training material, etc.

The fact that only few members of Sigma contributed information and that the information communicated through the system often lacks relevance has made staff even more hesitant to work with SigSys.

4.4 Problem Category 2: General Problems Regarding the Use of SigSys

The following problems are grouped in two general categories: Motivational factors and heterogeneity of use (for an overview, see Figure 2). ***Motivational factors*** turned out to be of high relevance, since VOs are often lacking mechanisms of obligatory conversion of management decisions concerning the use of information technologies throughout enterprises. We identified two motivational factors:

- *Acceptance of the system.* The acceptance of the system and the acceptance of its application are important prerequisites for the motivation to use the system. Underlying other problems, we found the problem of *lack of participation* to be essential. The problem has, in part, been provoked by the way SigSys was introduced to Sigma, which was essentially non-participatory. Since a group of computer specialists within Sigma was prevented from contributing their own conceptions of what an appropriate system should look like, this group still does not accept SigSys.

- *Subjective system relevance*. For the individuals interviewed, the question of the subjective relevance of the system is to a large extent independent of the acceptance of the system. We could identify two causal factors of subjective relevance: First, the *informedness* of an employee reflects his knowledge about the organizational coherence and whether he or she knows who to turn to in order to gain access to specific information. In the context of our exploration we discovered that some individuals were so well informed that they often already possessed information before it appeared in SigSys. Other individuals depended to a great extent on the information presented in the system. Aspects such as being new to the network and spatial or personal marginalization complicate access to information. Second, the *necessity to cooperate* with other people or departments differs. The necessity to cooperate also influences the necessity for the use of the system.

Beyond the issue of motivation, we identified problem constellations that were due to the highly ***heterogeneous use*** of the system. When a request for trainers to put together a team was addressed, at short notice, to a SigSys panel, only a few individuals responded. Furthermore, the initiator of the inquiry could not differentiate whether the trainers were not interested, were busy, or had not read the message at all. Complex negotiations by telephone followed, which could have been avoided by the application of the system. Concerning the *frequency*, the use of SigSys differs between several times daily and almost never. Concerning the *intensity of use*, we identified patterns of usage ranging from regular participation in all discussion groups up to the use of only selected aspects of the system.

5. DESIGN OF GROUPWARE IN THE CONTEXT OF VIRTUAL ORGANIZATIONS

Suggestions for the design of groupware that satisfy the specific needs of virtual organizations are derived from the results of our empirical investigation and the theoretical considerations regarding virtual organizations. However, the design suggestions do not claim to be complete. They are to be understood, rather, as a first step in the debate on the design of groupware for virtual organizations. Furthermore, it is important to point out that there is no catalog of design suggestions, however complete it may be, that would meet the requirements of all team-oriented virtual organizations. Similar to classical organizations, VOs require that the particular organizational setting of each organization be taken into account. Approaches based on an integrated development of organization and technology seem to be adequate in this context (Stiemerling, Wulf, and Rohde 1998).

To derive design suggestions, we related the identified problem categories to the main enabling factors of team-based VOs, which were described in section 1. The enabling factors provide clues to the technical support of some vital processes within VOs. The need for all of these factors was confirmed by our empirical findings. Furthermore, the empirical work indicates that additional support is needed. The interdependency between the suggested design goals, the empirical findings, and the enabling factors are illustrated in Figure 3.

In the following, we will explain the derived design goals. As the support of cooperation and coordination (c) is a general demand, we will not consider it in detail. For an explanation of basic concepts, see Ellis, Gibbs, and Rein (1991).

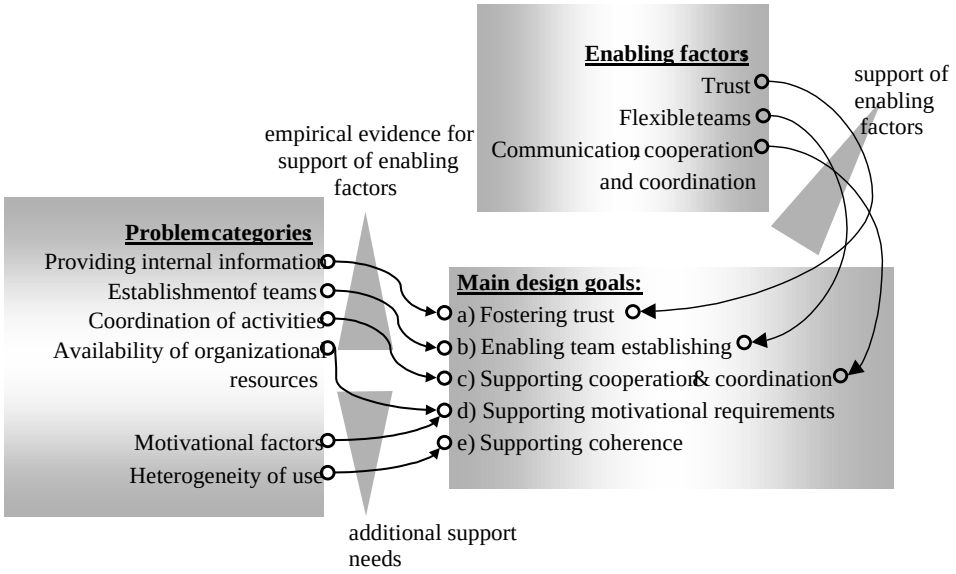

Figure 3. Dependencies Between Design Goals, Problem Categories and Enabling Factors

(a) Fostering trust. Trust is an important means to create social cohesion in an organization which, like a VO, displays only loose interpersonal ties (Jarvenpaa and Shaw 1998). We will consider the fostering of trust between individuals by means of groupware. The trust of individuals in a technical system is considered in section (d), supporting motivation. The main subjects we examined regarding trust are, on the one hand, the provision of information and, on the other, the visibility of information and particularly of activities.

CSCW research provides several concepts concerning these subjects. *Awareness* serves to supply synchronous and/or asynchronous information about the activities of other users (McDaniel and Brinck 1997) and aims at supporting the joint work with shared artifacts. Just as awareness is important for the provision of information, *privacy* is essential when it comes to preventing monitoring of activities and protecting confidential data (Bellotti and Sellen 1993; Clement 1994). Concepts of providing information in general, and information of user activities in particular, have to take into account the delicate balance between the need for accessibility of awareness-information and the need for protection of privacy-information. We postulate that decisions about which degree of awareness or privacy is needed have to be made first and foremost by the user. Techniques of negotiation could help to overcome possible conflicts (Rohde and Wulf 1996).

(b) *Enabling the establishment of teams*. We argue that two factors are essential to support the establishment of teams. First, providing information about skills and experience in a database could help to overcome problems arising from the absence of personal relationships. In this database, entries have to be edited by the particular owner of the information provided, so the individual concerned is himself responsible for putting out an adequate skill-description and for keeping it up-to-date. Second, the procedure of establishing a team, often made difficult by narrow time frames, has to be supported by mechanisms that provide the person establishing the team with clear feedback as to whether a person is interested, not interested, not available, does not feel competent, etc. Shared schedules of appointments, including predefined answer formulas, seem to be useful tools in that context. For a detailed discussion of the application of meeting schedulers within organizations, see Grudin and Palen (1995).

(d) *Supporting motivational requirements*. Within the fields of HCI and CSCW, several factors have been suggested which promote the motivation of system use. First, access rights protect confidential data and enable a graded control over information (Shen and Dewan 1992). Second, visibility of the system's reactions (Herrmann, Wulf,and Hartmann 1996) helps to understand how the system works and how data is processed.

Other factors are more closely related to the application of groupware. Grudin (1994) mentions two central factors regarding motivation: The *disparity in who did the work and who got the benefit* and the necessity to have a *critical mass of users*. Regarding VOs, the disparity problem is aggravated by the lack of availability of organizational resources, particularly time and money. This hinders the provision of information about knowledge, experience and activities which is vital for that kind of organization. Regarding the experience in our field of investigation, it is the absence of initiative that often prevents users from providing information by themselves. A core pool of information provided by several people could help to increase the use of

the system and the motivation to contribute to its contents. Technically, this process can be supported by possibilities of self-organized, user-initiated filing and structuring of information.

Finally, the process of introducing and designing groupware is of enormous interest. While participatory approaches (cf. Namioka and Schuler 1993) have become a *de facto* standard within CSCW, lack of time and the geographical distribution of organization members are often hurdles for the application of such concepts. Existing methods have to be adapted in such a way that they enable both the participation of users considering strongly different requirements and the effective use of time resources.

(e) *Supporting coherence*. Flexible reaction to market changes is a major quality of a VO. To achieve this flexibility internal processes are less standardized than in classical organizations. As we have shown in our investigation, this causes problems like the *heterogeneity of use*. As classical instruments, such as standardization, must fail in this environment, alternative forms of supporting coherence have to be found. In our opinion, coherence has to be understood in the sense of coherence on the level of local teams and individuals who interact and negotiate coherence themselves whenever they deem it necessary. To this end, one has to provide the means that permit local non-permanent/temporary conventions between teams or individuals. Current concepts of conventions regarding the use of a groupware system as mentioned in the CSCW literature are assumed to be obligatory for the whole organization (Wulf and Mark 1997). Means of flexible, electronically supported negotiations of conventions have to be added to allow a high degree of flexibility and to adjust conventions to the organizational setting (cf. Rohde and Wulf [1996] for computer-supported negotiations).

6. CONCLUSIONS

The concept of virtual organizations (VOs) still—and probably for quite a while in the future—remains without a clear-cut definition in the literature. Nevertheless, there are already many examples of companies perceiving themselves as VOs. While VOs declaredly depend on information and communication technology, their (non-)structure poses a particular challenge to information and communication system design. Investigating a concrete team-oriented VO, we encountered several problems that, combined with the identified enabling factors of team-oriented VOs, served as a first basis to reason about design. We believe that those problems and enablers, many of which are on the intersection of organization and technology, are inherent to a whole group of VOs. Without claiming completeness, we identified five goals for designing groupware for team-oriented VOs. While the scope of our paper was on technical solutions, it is clear that the support of VOs needs to be accomplished through organizational and technological measures and the adequate connection of both. Further work needs to be done on what kind of support is suitable for what kind of VO.

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